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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the suitable alumino borosilicate glass for an ampul, the substrate for liquid crystal displays, the substrate for photo masks, the substrate for magnetic disks, etc.
[0002]
[Description of the Prior Art]The alumino borosilicate glass which is excellent in chemical durability and heat resistance is widely used for substrates, such as an ampul and a substrate for liquid crystal displays, etc.
Production by a glass melting furnace is performed.

[0003]
[Problem(s) to be Solved by the Invention]Conventionally, any one sort of Cl, As_2O_3, and the Sb_2O_3 is added by alumino borosilicate glass for the defoaming. However, much more reduction of the bubbles which remain in alumino borosilicate glass is called for in recent years. This invention aims at offer of the alumino borosilicate glass which can reduce bubbles.
[0004]
[Means for Solving the Problem]This invention is the mass percentage display of a following component standard, and intrinsically 45 to 78% of SiO_2, 2 to 22% of $aluminum_2O_3$, 4 to 15% of B_2O_3, Li_2O 0-2%, Na_2O 0-10%, K_2O 0-3%, 0 to 5% of MgO, 0 to 8% of CaO, 0 to 10% of SrO, and 0 to 17% of BaO, Cl+F, ** and others, provides alumino borosilicate glass which is 0.05% or more 0 to 10% of ZnO, 0 to 0.15% of Fe_2O_3, 0 to 0.015% of SO_3, 0 to 1% of Cl, and F 0-0.5%.

[0005]

[Embodiment of the Invention]As for the strain point of the alumino borosilicate glass (henceforth the glass of this invention) of this invention, it is preferred that it is 520-700 **. At less than 520 **, there is a possibility that heat resistance may be too low. There is a possibility that shaping may become difficult, at more than 700 **. 660 ** [560 ** or less] or less 570 ** or less is 550 ** or less most preferably especially preferably still more preferably.

[0006]Intrinsically the glass of this invention by the mass percentage display of a following component standard 45 to 78% of SiO_2, 2 to 20% of aluminum$_2O_3$, 4 to 15% of B_2O_3, Li_2O 0-2%, Na_2O 0-10%, K_2O 0-3%, The thing, ** and others, is preferred 0 to 5% of MgO, 0 to 6% of CaO, 0 to 10% of SrO, 0 to 17% of BaO, 0 to 10% of ZnO, 0 to 0.15% of Fe_2O_3, 0.001 to 0.015% of SO_3, 0.05 to 0.8% of Cl, and F 0-0.3%.

[0007]Next, the presentation of the glass of this invention is explained using a mass percentage display. SiO_2 is network former and indispensable. At more than 78%, the solubility of glass falls, or it is easy to devitrify and becomes. It is 76% or less preferably. Acid resistance or alkali resistance falls at less than 45%. It is not less than 61% more preferably not less than 48%.

[0008]aluminum$_2O_3$ is an ingredient which controls the phase separation of glass or makes a strain point high, and is indispensable. At more than 22%, it becomes easy to devitrify or acid resistance falls. It is 19% or less more preferably 20% or less. At less than 2%, it becomes easy to carry out phase splitting of the glass, or a strain point falls. It is not less than 3% preferably. As for the content of aluminum$_2O_3$, when the content of SiO_2 is not less than 61%, it is preferred that it is 10% or less.

[0009]B_2O_3 makes high solubility of glass which makes chemical durability high, or is an ingredient which make glass hard to devitrify, and is indispensable. The heterogeneity of the glass with which a strain point falls and with which acid resistance falls or originates in vaporization of B_2O_3 at the time of glass melting becomes remarkable at more than 15%. It is 13% or less preferably. At less than 4%, the solubility of glass to which chemical durability falls falls, or it is easy to devitrify glass and it becomes. It is not less than 7% more preferably not less than 5%.

[0010]Although all Li_2O, Na_2O, and K_2O are indispensable, in order to enlarge an expansion coefficient, it may contain to 2%, 10%, and 3%, respectively. If contained exceeding this, chemical durability or a strain point will fall. As for the sum total of the content of Li_2O, Na_2O, and K_2O, it is preferred that it is 1% or more to carry out the mean coefficient of linear

expansion alpha at 50-350 ** more than 50x10 $^{-7}$/**.

[0011]Although MgO is not indispensable, in order to make solubility of glass high, it may contain to 5%. At more than 5%, it becomes easy to carry out phase splitting of the glass, or it is easy to devitrify glass and it becomes. Although CaO is not indispensable, in order to make solubility of glass high, or in order to make glass hard to devitrify, it may contain to 8%. It becomes on the contrary easy to devitrify at more than 8%. It is 6% or less preferably.

[0012]Although SrO is not indispensable, in order to control the phase separation of glass, or in order to make glass hard to devitrify, it may contain to 10%. It becomes on the contrary easy to devitrify at more than 10%. Although BaO is not indispensable, in order to control the phase separation of glass, or in order to make glass hard to devitrify, it may contain to 17%. It becomes on the contrary easy to devitrify at more than 17%. Although ZnO is not indispensable, in order to make chemical durability high, it may contain to 10%. Chemical durability, especially acid resistance fall on the contrary at more than 10%.

[0013]Although Fe_2O_3 is not indispensable, in order to control the heat convection of the melting glass in a glass melting furnace, it may contain to 0.15% for promotion of defoaming. At more than 0.15%, said heat convection is controlled, and it actually becomes difficult to defoam, or homogeneity falls.

[0014]Although SO_3 is not indispensable, in order to promote defoaming or the dissolution of raw materials for glass, it may contain to 0.015%. It re-** at more than 0.015% at the time of churning. It is 0.01% or less more preferably 0.012% or less. It is preferred to contain SO_3 0.001% or more to promote more defoaming or the dissolution of raw materials for glass. It is 0.0012% or more more preferably. Although SO_3 content is usually performed by adding sulfate, such as Glauber's salt, to raw materials for glass, for example in fuel oil combustion kiln, it originates also in S dross inclusion of a fuel oil.

[0015]Cl and F are the ingredients for defoaming, and must contain either at least. At less than 0.05%, defoaming of sum total Cl+F of the content of Cl and F becomes insufficient. As for Cl+F, it is preferred that it is 1% or less.

[0016]Cl may be contained to 1% for defoaming or said re-******. Re-** which originates in Cl on the contrary happens at more than 1%. It is 0.5% or less more preferably 0.8% or less. Containing 0.05% or more is preferred to promote more re-****** resulting from defoaming or said SO_3. It is 0.1% or more more preferably.

[0017]F reduces the surface tension of melting glass, has an effect which make it easy to tear in the bubble which exists in a melting glass surface, or an effect which reduces the minute bubbles in melting glass, and may be contained to 0.5%. At more than 0.5%, vaporization increases and the homogeneity of glass falls. It is 0.3% or less preferably.

[0018]In the glass of this invention, in CaO, SO_3 comes out 0 to 6% 2 to 20%, in Cl, F comes out [aluminum$_2O_3$] 0 to 0.3% 0.05 to 0.8% 0.001 to 0.015%, and a certain thing is preferred.

[0019]Although the glass of this invention consists of the above-mentioned ingredient intrinsically, other ingredients, for example, TiO_2, ZrO_2, etc. may be contained in the range which does not spoil the purpose of this invention. As for the sum total of the content of the ingredient of said others, it is preferred that it is 10% or less. It is 5% or less more preferably.

[0020]As for the glass of this invention, it is preferred not to contain As_2O_3. It is preferred not to contain Sb_2O_3, either. It is more preferred to contain neither As_2O_3 nor Sb_2O_3. "Content of an impurity level" is included saying "it does not contain" as used in this specification. Namely, speaking of the case of As_2O_3 and Sb_2O_3, It is an impurity level with content typical about all not more than 0.05% or it, and though the glass of this invention contains As_2O_3 or Sb_2O_3, it is preferred that it is an impurity level.

[0021]The glass of this invention is suitable for substrates, such as an ampul and a substrate for liquid crystal displays, etc.

[0022]The method in particular of manufacturing the glass of this invention is not limited, but can adopt various manufacturing methods. For example, the raw material by which normal use is carried out is prepared so that it may become a target system, and this is heated and fused at 1500-1700 ** in a glass melting furnace. Bubbling or churning performs melting homogenizing of glass.

[0023]Publicly known melting glass reduced pressure defoaming treatment may be performed as the previous process or post process of melting homogenizing of glass, and much more bubble reduction may be aimed at. When agitating, it is effective in the ability to perform [if reduced pressure defoaming treatment is performed as the previous process, re-** will be controlled, and] said churning more strongly as a result. Here, a vacuum defoaming process is a process of holding the glass by which melting was carried out under atmospheric pressure under the pressure of less than atmospheric pressure, and a pressure typically lower 0.5 atmospheres or more than atmospheric pressure, and it is provided for the promotion of defoaming of melting glass.

[0024]When using it as substrates, such as a substrate for liquid crystal displays, it fabricates to predetermined board thickness by methods, such as a method of pressing well-known, the down draw method, and a float glass process, grinding, polish, etc. are processed after annealing, and it is considered as the substrate of predetermined size and shape. When using it as an ampul, by methods, such as the well-known Danner method, it fabricates to a glass tube, this glass tube is processed, and it is considered as an ampul.

[0025]

[Example]After the dissolution and churning and with a float glass process, it cooled after fabricating to tabular, the glass melting furnace cut the raw material prepared so that it might become the presentation shown in SiO_2 of Table 1 - the column of F by mass percentage display, and the glass plate (50 cm x 100 cm) (thickness: 1 mm) was obtained. Said churning was performed within the uniformity tub provided between the glass melting furnace and the float bus, and the revolving speed was considered as a part for /10 times. alpha (unit: 10^{-7}/**) of said glass plate, a strain point (unit: **), and an annealing point (unit: **) are shown in Table 1. Examples 1-4 are examples and Example 5 is a comparative example.

[0026]It counted, while the size which exists in said glass plate irradiated the glass plate from the high-intensity point light source (mercury lamp) installed 50 cm apart from a glass plate all over the dark room in the number of not less than 20-micrometer bubbles. The strength of the stria which exists in said glass plate was investigated. The number of the bubbles per 1 kg of glass is shown in the column of the bubble of Table 1, and the strength of a stria is shown in the column of the degree of homogeneousness, respectively. As for the number of bubbles, it is preferred that it is 0.1 or less piece/kg. The strength of the stria made O what is permitted as a substrate for liquid crystal displays, and made x what is not permitted.

[0027]

[Table 1]

例	1	2	3	4	5
SiO_2	72.3	59.2	56	81	72
Al_2O_3	4.7	17.7	11	2.4	5.1
B_2O_3	9.2	8	5.9	12.4	9.1
Li_2O	0.10	0	0	0	0
Na_2O	6.1	0.01	0.05	2.3	6
K_2O	0.5	0	0	0.5	0.5
MgO	0.02	2.8	2.1	0.03	0.02
CaO	0.35	4.5	3	0.04	0.4
SrO	0	7.5	6.5	0	0
BaO	5.5	0.1	15.1	0	4
ZnO	2.7	0	0	0	2.5
Fe_2O_3	0.06	0.07	0.05	0.10	0.06
TiO_2	0.05	0.04	0.04	0.03	0.05
ZrO_2	0.05	0.04	0.10	0	0.05
SO_3	0.0025	0.004	0.01	0.003	0.005
Cl	0.34	0.16	0.45	0.10	0.01
F	0.09	0.06	0.09	0.03	0
α	51	38	49	32	52
歪点	530	660	635	520	535
徐冷点	570	715	690	565	575
泡	0.1 以下	0.1 以下	0.1 以下	0.1 以下	5
均質度	○	○	○	○	×

[0028]The raw material prepared so that it might become the presentation shown in SiO_2 of Table 2 - the column of F by mass percentage display was paid to the platinum crucible, and within the electric furnace, after the dissolution and churning, it was begun to tabular on the carbon plate to pour melting glass, and cooled. The obtained glass was cut and ground and it was considered as the glass plate (10 cm x 20 cm) (thickness: 6 mm). Said churning was performed for 30 minutes using the stirrer made from platinum, and the revolving speed was considered as a part for /5 times. alpha (unit: 10^{-7}/**) of said glass plate, a strain point (unit: **), and an annealing point (unit: **) are shown in Table 2. Examples 6 and 7 are examples and Example 8 is a comparative example.

[0029]The size which exists in said glass plate counted the number of not less than 20-micrometer bubbles all over the dark room, irradiating with the light from the high-intensity point light source (mercury lamp) from the glass plate side. The strength of the stria which exists in said glass plate was investigated. The number of the bubbles of per glass 1g is shown in the column of the bubble of Table 2, and the strength of a stria is shown in the column of the degree of homogeneousness, respectively. As for the number of bubbles, it is preferred that it is 0.02 or less piece/g. The strength of the stria made O what is permitted as a substrate for

liquid crystal displays.

[0030]

[Table 2]

例	6	7	8
SiO_2	72	63	57.2
Al_2O_3	5.1	17	15.7
B_2O_3	9.1	8	11.2
Li_2O	0	0	0
Na_2O	6	0	0.05
K_2O	0.5	0	0
MgO	0.02	1.5	1.3
CaO	0.4	6.5	3.5
SrO	0	3.5	4
BaO	4	0	5.8
ZnO	2.5	0	0
Fe_2O_3	0.06	0.07	0.02
TiO_2	0.05	0.04	0.04
ZrO_2	0.05	0.06	0.06
SO_3	0.001	0.002	0
Cl	0.005	0.15	1.5
F	0.12	0.25	0.1
α	52	38	40
歪点	532	680	640
徐冷点	573	730	690
泡	0.02 以下	0.02 以下	0.5
均質度	○	○	○

[0031]

[Effect of the Invention]The glass of this invention has few bubbles, and is alumino borosilicate glass excellent in homogeneity.

A quality ampul, a liquid crystal display substrate, the substrate for photo masks, the substrate for magnetic disks, etc. are obtained.

[Translation done.]